WATER RESOURCES REVIEW for

JUNE

1973

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH

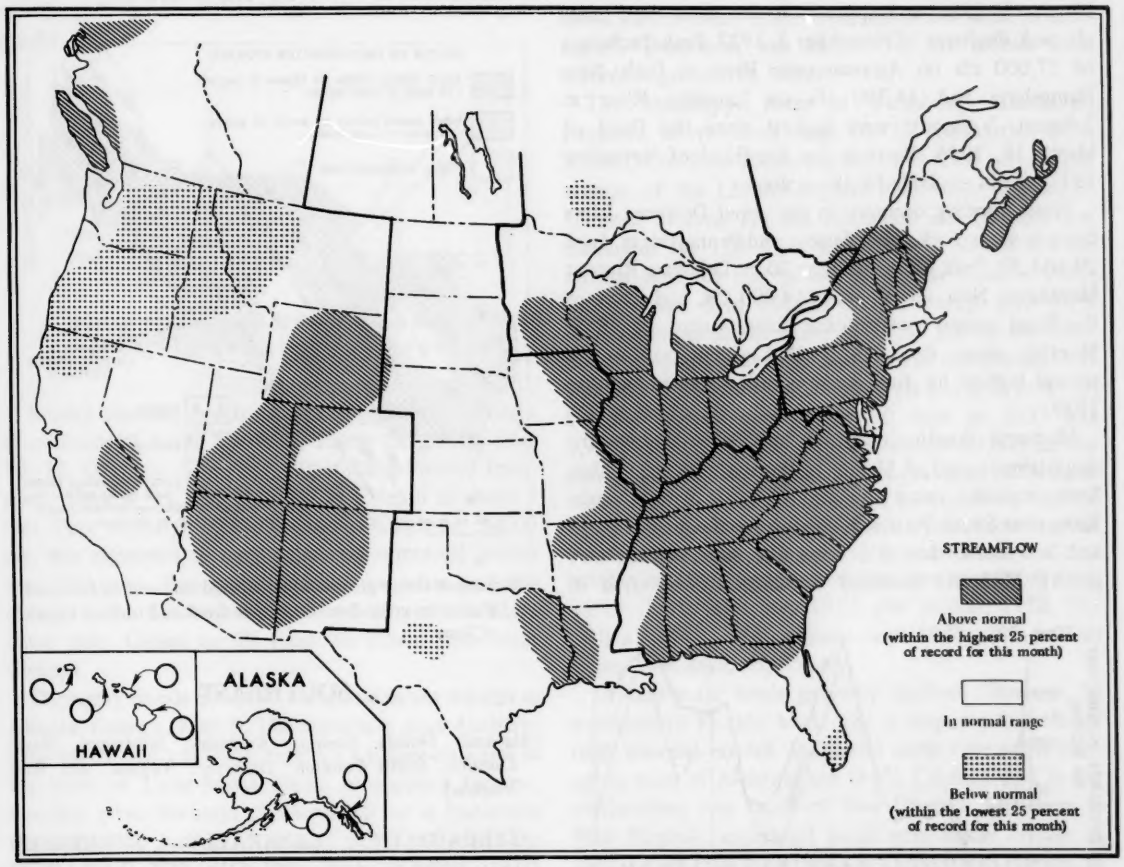
STREAMFLOW AND GROUND-WATER CONDITIONS

Streamflow generally decreased in southern Canada, Hawaii, and in most parts of the conterminous United States, but increased in parts of Alberta and British Columbia, and in part of Alaska and in a few basins elsewhere in the United States.

Above-normal streamflow conditions occurred in much of eastern and southwestern United States, and in extreme southeastern and southwestern Canada. Below-normal flows persisted in many of the northwestern States, and in small areas of Texas, Florida, and the Province of Ontario.

Flooding occurred in parts of Alaska, Texas, Louisiana, and many eastern States, from South Carolina to Maine.

The Mississippi River at Vicksburg, Mississippi, receded to below flood stage June 20 for the first time in 89 days. The average flow at that site, March 3 to June 30, was 1,500,000 cfs, highest of record for a period of 120 consecutive days.



CONTENTS OF THIS ISSUE: Northeast, Southeast, Western Great Lakes, Midcontinent, West, Alaska; Hydrographs of two large rivers; Usable contents of selected reservoirs near end of June 1973; Flow of large rivers during June 1973; Quality of the ground water in basalt of the Columbia River Group, Washington, Oregon, and Idaho.

NORTHEAST

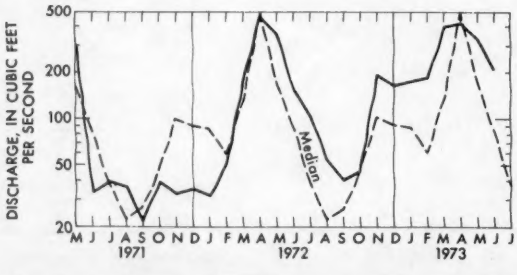
[Atlantic Provinces and Quebec; Delaware, Maryland, New York, New Jersey, Pennsylvania, and the New England States]

STREAMFLOW DECREASED THROUGHOUT THE REGION BUT GENERALLY WAS ABOVE THE NORMAL RANGE IN PARTS OF ALL STATES AND PROVINCES EXCEPT CONNECTICUT, MASSACHUSETTS, RHODE ISLAND, QUEBEC, AND NEW BRUNSWICK. MODERATE TO SEVERE FLOODING OCCURRED AT MONTHEND IN PARTS OF PENNSYLVANIA, NEW JERSEY, CONNECTICUT, NEW YORK, VERMONT, NEW HAMPSHIRE, AND MAINE.

Severe flooding occurred in most of Vermont and north-central New Hampshire June 30. Peak flow of many streams in Vermont was the greatest since the flood of November 1927. At Montpelier, Vermont, peak discharge of 13,900 cfs June 30 on Winooski River was somewhat less than the peak of 15,600 cfs observed March 18, 1936, and appreciably less than the 57,000 cfs peak discharge of November 3, 1927. Peak discharges of 37,000 cfs on Ammonoosuc River at Bath, New Hampshire, and 14,300 cfs on Lamoille River at Johnson, Vermont, were highest since the flood of March 18, 1936. Records for the flood of November 1927 are not available for those sites.

Flash flooding occurred in the upper Delaware River basin in New York, New Jersey, and Pennsylvania, June 29 and 30. Peak discharge June 30 on Delaware River at Montague, New Jersey, was 114,000 cfs, highest since the flood caused by Hurricane Diane, August 19, 1955. Monthly mean discharge at that gaging station was second highest for June since records began in October 1939.

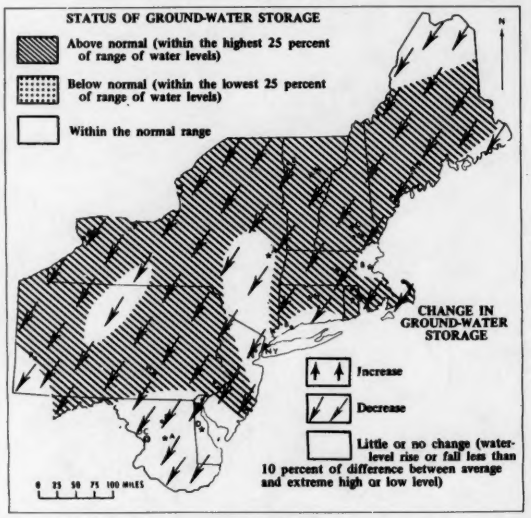
Moderate flooding occurred June 30 in the western mountainous part of Maine. In the southern tip of that State, monthly mean discharge of Little Androscoggin River near South Paris remained above the normal range and was more than 2½ times the June median (see graph). Moderate localized flooding also occurred in small basins in New Jersey, eastern Pennsylvania, southeastern New York, and western Connecticut, June 28, 29. Elsewhere in New Jersey and Pennsylvania, streamflow decreased but was above the normal range, in contrast to Connecticut, where flows generally were above normal in May and decreased into the normal range during June.



Monthly mean discharge of Little Androscoggin River near South Paris, Maine. (Drainage area, 76.2 square miles.)

Monthly mean discharge at all index stations in Nova Scotia was above the normal range, as a result of excessive rainfall June 14–19. In southeastern Quebec, flow at the index station, St. Francois River at Hemming Falls decreased but was above the normal range for June. Elsewhere in Quebec, and in New Brunswick, streamflow was in the normal range.

Ground-water levels declined seasonally in nearly the entire region. However, monthend levels were in the above-normal range for June in parts of all ten States (see map), mainly as a result of carryover of high levels from May. End-of-June levels in some wells were highest for the month in at least 20 years of record.


STATUS OF GROUND-WATER STORAGE
Above normal (within the highest 25 percent of range of water levels)
Below normal (within the lowest 25 percent of range of water levels)
Within the normal range
N
CHANGE IN GROUND-WATER STORAGE
Increase
Decrease
Little or no change (water-level rise or fall less than 10 percent of difference between average and extreme high or low level)
0 25 50 75 100 MILES

Map above shows ground-water storage near end of June and change in ground-water storage from end of May to end of June.

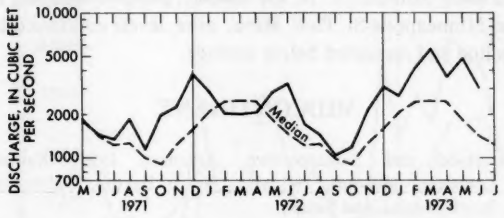
SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

STREAMFLOW GENERALLY DECREASED THROUGHOUT THE REGION BUT REMAINED ABOVE THE NORMAL RANGE AT MANY INDEX STATIONS. FLOODING OCCURRED IN PARTS OF NORTH AND SOUTH CAROLINA AND GEORGIA,

AND MONTHLY MEAN DISCHARGES WERE HIGHEST OF RECORD FOR JUNE ON SOME STREAMS IN ALABAMA, FLORIDA, AND GEORGIA. MISSISSIPPI RIVER NEAR VICKSBURG RECEDED TO BELOW FLOOD STAGE JUNE 20 FOR THE FIRST TIME IN 89 DAYS.

In west-central North Carolina, severe local flooding occurred in Briar Creek and Sugar Creek basins in the city of Charlotte June 15, causing much property damage. Minor flooding occurred on small streams in the east near monthend. Monthly mean discharge of South Yadkin River near Mocksville, also in the west-central area, remained above the normal range for the 5th consecutive month. Cumulative runoff at that index station, for the first nine months of 1973 water year, October 1972 through June 1973, was second highest for that period in 42 years of record. Monthly mean discharge of French Broad River at Asheville, in the west, also remained above the normal range for the 5th consecutive month, and was more than double the June median (see graph).



Monthly mean discharge of French Broad River at Asheville, N.C. (Drainage area, 945 square miles.)

Record-breaking floods occurred in Black River basin in east-central South Carolina, during the period June 10–16. Overflow from Pocotaligo River flooded Interstate Highway 95 near Manning to a depth of about 3 feet. Peak discharge of Black River at Kingstree, 58,000 cfs, was estimated to have a recurrence interval greater than 200 years. Recurrence intervals for other peak discharges in the flood area varied from 20 years on Black River near Gables to 50 years on Edisto River near Givhans.

Damaging floods occurred on several urban streams in Atlanta, Georgia, June 5. The maximum peak discharge determined was 2,960 cfs from a 5.1-square-mile area in the basin of Long Island Creek. In southern Georgia, monthly mean discharge of Alapaha River at Statenville was highest for June in 44 years of record and was in the above-normal range for the 3d consecutive month.

In southern Alabama, mean flow of Conecuh River at Brantley, was highest for June in record that began in October 1935. Flows were above normal in all parts of that State.

In north-central Florida, the monthly mean discharge of 19,200 cfs, and the daily mean of 22,200 cfs June 30, at the index station Suwannee River at Branford, were highest for June in 42 years of record. Flow of Shoal River near Crestview, in northwest Florida, remained above the normal range for the 7th consecutive month. Monthly mean discharge at that index station also was record high during May. Flow of Silver Springs decreased 17 cfs, to 745 cfs; 97 percent of normal for the month. Flow southward through the Tamiami Canal outlets, 40-mile bend to Monroe, increased from zero to 15 cfs, which is 18 percent of normal. Flow of Miami Canal at Miami increased from zero to 73 cfs; 21 percent of normal.

Streamflow remained above the normal range in all parts of Tennessee. Flows in the western half of that State have been above normal for the past four months. The daily mean discharge of 32,000 cfs on June 1, at the index station Duck River above Hurricane Mills, in west-central Tennessee, was highest for the month since records began in July 1925.

The Mississippi River at Vicksburg, Mississippi, remained above flood stage for 89 consecutive days, March 24 to June 20, during the 1973 flood period. The average of the 120 consecutive daily mean discharges, March 3 to June 30, was 1,500,000 cfs. This is a new maximum for 120 days, exceeding by 50,000 cfs the average flow for that period during the flood of 1945, and by more than 100,000 cfs the average flow for a similar period in the flood of 1950. During the 1937 flood, the highest average flow for 120 consecutive days was only 1,150,000 cfs, 350,000 cfs less than in 1973, but the highest average for 30 days in 1937 was 1,940,000 cfs, exceeding by more than 50,000 cfs the average flow for the highest 30-day period in 1973, April 26 to May 25. Cumulative runoff at Vicksburg, for the first nine months of the 1973 water year, including the flood period, was 319 million second-foot-days. Comparable runoff volumes for the first nine months of some earlier flood years are: 1927, 284 million; 1950, 252 million; 1945, 234 million; and 1937, 207 million second-foot-days, respectively.

Ground-water levels generally declined. However, in southeastern Florida, levels rose in response to recharge from seasonal rainfall. Monthend levels were above average in most of Alabama and North Carolina, and in the southeastern two thirds of West Virginia. Elsewhere in West Virginia, monthend levels were below average as they were also in many wells in southeastern Florida. In northern Kentucky near Louisville, the level in the key observation well in the Ohio River valley was again at a

new alltime high in 27 years of record. In the extreme southwestern part of the State, an observation well with 28 years of record also reached a new alltime high water level.

WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

STREAMFLOW INCREASED IN SOUTHERN ILLINOIS, INDIANA, AND WEST-CENTRAL OHIO, AND DECREASED IN ALL OTHER PARTS OF THE REGION. FLOWS GENERALLY WERE ABOVE THE NORMAL RANGE IN THE SOUTHERN AND WESTERN PARTS OF THE REGION, AND REMAINED BELOW NORMAL IN SOUTHWESTERN ONTARIO. SOME FLOODING OCCURRED IN PARTS OF ILLINOIS, INDIANA, AND OHIO.

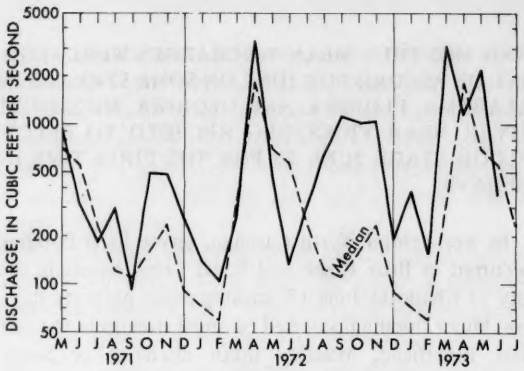
In Illinois, the monthly mean discharges of 2,333 cfs on Pecatonica River at Freeport (drainage area, 1,330 square miles), and 2,102 cfs on Sangamon River at Monticello (550 square miles), were the highest for June in 59 and 65 years of record, respectively. Flow at Freeport remained above the normal range for the 10th consecutive month. Flooding has persisted in some parts of the State since late April.

Streamflow increased in Indiana and was above normal at all index stations. Minor flooding occurred in the upper reaches of West Fork and East Fork of White River, in Wabash River basin, and monthly mean discharge of Wabash River at Mt. Carmel, Illinois, downstream from White River, was twice the June median, and above the normal range.

Flows also increased and were above normal in western and central Ohio; minor flooding occurred along some streams in the central part of the State following heavy rains June 17 and 19.

In northwestern Wisconsin, flow of Jump River at Sheldon decreased sharply during June, to 65 percent of median (see graph). In southern and eastern basins of the State, streamflow remained above the normal range. Flow of Wisconsin River at Muscoda, in the south, was more than 1½ times the June median, and flows of Oconto and Fox Rivers, in the east, were about 2½ times median. Flows also decreased sharply in northern Michigan and were in the normal range, but in the southern part of that State streamflow remained above normal as a result of high carryover flow from May.

Flow of English River at Umfreville, in southwestern Ontario, remained in the below-normal range, but elsewhere in the Province streamflow was in the normal range for June.



Monthly mean discharge of Jump River near Sheldon, Wis. (Drainage area, 574 square miles.)

Ground-water levels declined in most of the region, but rose in central Ohio, east-central Indiana, and the north-central part of Michigan's Lower Peninsula. Monthend levels continued to be above average for June in northern Minnesota and most of Indiana, and were above average also in Ohio. End-of-June levels were near or above average in Michigan, and were below average in southern Minnesota. In the heavily pumped aquifers in the Minneapolis-St. Paul, Minn. area, levels continued to decline and remained below average.

MIDCONTINENT

[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

STREAMFLOW INCREASED IN PARTS OF MANITOBA, SOUTH DAKOTA, NEBRASKA, OKLAHOMA, AND TEXAS, AND DECREASED ELSEWHERE IN THE REGION. FLOWS REMAINED ABOVE NORMAL IN NORTHEASTERN IOWA AND EAST-CENTRAL TEXAS, AND BELOW NORMAL IN WEST-CENTRAL TEXAS. FLOODING OCCURRED IN WESTERN LOUISIANA AND IN EASTERN AND SOUTHERN TEXAS.

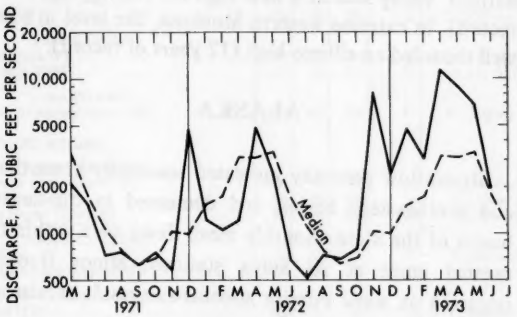
In southeastern Texas, peak discharges with recurrence intervals ranging between 25 and 50 years, occurred on several streams in the lower Trinity River and San Jacinto River basins north and east of Houston, following heavy rains that began June 11. Lavaca and Navidad Rivers in southern Texas, crested at midmonth, equalling the floods of 1936 and 1940. In west-central Texas, flows in the upper reaches of Brazos River, and on North Concho River near Carlsbad, were below normal.

In eastern Iowa, flow of Cedar River at Cedar Rapids receded from the record-high rate of May but remained in the above-normal range for the 12th consecutive month. Streamflow generally was above normal throughout the State and near-bankfull stages occurred on several streams.

Flows in South Platte, North Platte, and mainstem Platte River remained above average in Nebraska during the month as a result of high carryover flow from May and releases from reservoir storage.

In Louisiana, the major streams—Mississippi, Red, and Ouachita-Black Rivers—receded from the outstanding floods of the last several months. At monthend all streams were at or below flood flow. Minor flooding occurred along small streams in western Louisiana at midmonth.

Flow of Gasconade River at Jerome, in southern Missouri, receded into the normal range, was near the median for June, and representative of streamflow throughout the State (see graph).



Monthly mean discharge of Gasconade River at Jerome, Mo. (Drainage area, 2,840 square miles.)

In Manitoba, flow at the index station, Waterhen River below Waterhen Lake, increased seasonally and remained in the normal range. The level of Lake Winnipeg at Gimli averaged 713.87 feet above mean sea level, 0.03 foot higher than the long-term mean for June and 0.35 foot lower than last month.

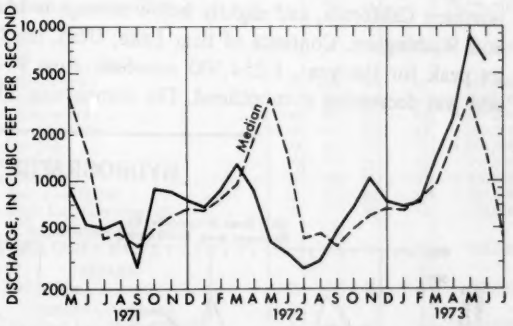
Ground-water levels declined in most of the region but rose in central parts of Texas, Louisiana, and Arkansas. Monthend levels were generally above average for June except in North Dakota, parts of Kansas, and extreme western and eastern coastal Texas. In Texas, alltime low water levels were recorded in the Ogallala Formation at Plainview and in the sand and gravel aquifer at El Paso. In Arkansas, the level in the observation well at El Dorado, in the heavily-pumped Sparta Sand, was more than 9 feet above average for June. In southwestern Louisiana, levels in the Chicot aquifer continued to decline as a result of substantial pumping for irrigation.

WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

STREAMFLOW GENERALLY INCREASED IN BRITISH COLUMBIA AND ALBERTA, AND IN COLORADO, UTAH, AND WYOMING, BUT DECREASED ELSEWHERE IN THE REGION. MONTHLY DISCHARGES WERE ABOVE NORMAL IN WESTERN BRITISH COLUMBIA AND MUCH OF THE SOUTHERN HALF OF THE REGION, AND BELOW NORMAL IN NORTHERN CALIFORNIA AND MOST OF OREGON, WASHINGTON, IDAHO, AND MONTANA.

Streamflow remained in the above-normal range for the 9th or 10th consecutive month at most index stations in Arizona and southwestern New Mexico. Monthly mean discharge of Gila River at the index stations near Gila, New Mexico and at head of Safford Valley, near Solomon, Arizona, was highest for June in 47 and 59 years of record, respectively. In northwestern Arizona, monthly mean flow of Virgin River at Littlefield was 506 cfs, highest for June since records began in October 1929, and nearly 7 times the median for the month. Spring runoff from snowmelt was nearly completed at monthend in New Mexico and streamflow there was decreasing rapidly. Flow of Rio Grande at Otowi Bridge near San Ildefonso, in the north-central part of that State, decreased seasonally but was about 4 times the June median (see graph). Streamflow also

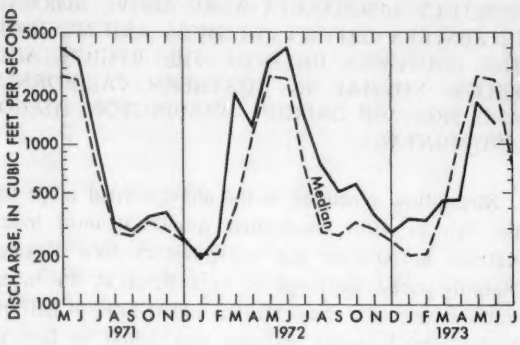


Monthly mean discharge of Rio Grande at Otowi Bridge, near San Ildefonso, N. Mex., (Drainage area, 14,300 square miles.)

remained above normal in parts of California, Colorado, Wyoming, and Utah, and increased into the above-normal range in west-central British Columbia and on Vancouver Island.

Monthly mean flows remained below the normal range in much of Oregon and Washington, and in

northern California, northern Idaho, and western Montana. Low runoff rates in these areas resulted generally from below-normal precipitation, low carry-over flow from May, and from light snowpack. For the past three months, below-normal flows have persisted on Marias River near Shelby, Montana (see graph), and on other streams in the western part of that State and in northern Idaho. In south-central Idaho, monthly mean flow of Boise River was tenth lowest for June in 79 years of record.



Monthly mean discharge of Marias River near Shelby, Mont. (Drainage area, 3,242 square miles.)

In Utah, the level of Great Salt Lake declined 0.30 foot during the month (to 4,200.25 feet above mean sea level), from a 20-year high of 4,200.55 feet, which was recorded on June 1. Maximum level recorded during June since records began in 1904 was 4,204.8 feet in 1923.

Reservoir storage at monthend generally was above average in Arizona, Nevada, Colorado, Wyoming, and northern California, and slightly below average in Idaho and Washington. Contents of Bear Lake, Utah, reached its peak for the year, 1,254,500 acre-feet, June 9–24, and was decreasing at monthend. The comparable 1972 peak was 1,399,300 acre-feet, on June 29. Contents of San Carlos reservoir, in Arizona, decreased, but was nearly 6 times the June 30 average at monthend. Contents of the Colorado River Storage Project increased 2,753,200 acre-feet during June.

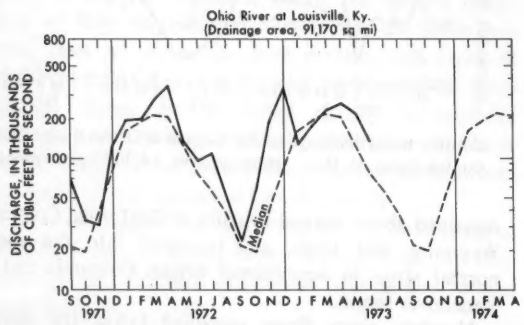
Ground-water levels generally rose in Montana, Idaho, and Nevada. Levels declined in most of Washington, eastern and southern Nevada, California, Arizona and New Mexico. Monthend levels were below average in much of the region, including most of Montana, Washington, extreme southern Idaho; much of California, Utah and Arizona; and in New Mexico. The water level in a key well in a heavily pumped area in northern Utah was lowest for June in the 25 years of record. New lows for the month were also recorded for wells in western and southern Nevada. Monthend levels were above average in northern Nevada and south-eastern Utah. In southern Idaho, levels in key wells in the Snake Plain aquifer near Atomic City and Eden were above average and a well in sand and gravel in the Boise Valley equaled the June high reached in 1972 (38 years of record). In southern Arizona, the level in a well representative of the irrigated area at the head of Safford Valley was at a new high for June (27 years of record). In extreme western Montana, the level in a key well recorded an alltime high (17 years of record).

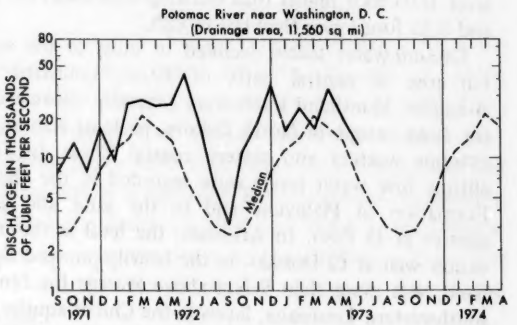
ALASKA

Streamflow generally increased seasonally in southern and southeastern basins, and decreased in the central basins of the State. Monthly mean flows were within the normal range at all index stations. Minor flooding occurred on some interior streams as a result of rain and snowmelt.

Ground-water levels in shallow alluvial aquifers began declining in the Kenai area and generally began rising in the Anchorage area.

HYDROGRAPHS OF TWO LARGE RIVERS





Provisional data; subject to revision

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF JUNE 1973

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of May 1973	End of June 1973	End of June 1972	Average for end of June	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	84	81	87	71	223,400 (a)
QUEBEC					
Gouin (P)	71	77	50	70	6,487,000 ac-ft
Allard (P)	94	90	89	82	280,600 ac-ft
MAINE					
Seven reservoir systems (MP)	99	97	98	86	179,300 mcf
NEW HAMPSHIRE					
Lake Winnipesaukee (PR)	105	117	104	95	7,200 mcf
Lake Francis (FPR)	90	97	96	87	4,326 mcf
First Connecticut Lake (P)	96	96	93	90	3,330 mcf
VERMONT					
Somerset (P)	97	91	96	86	2,500 mcf
Harriman (P)	74	84	82	83	5,060 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	93	91	94	88	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	100	92	105	92	34,270 mcf
Indian Lake (FMP)	109	103	107	101	4,500 mcf
New York City reservoir system (MW)	104	99	100	.....	547,500 mg
NEW JERSEY					
Wanaque (M)	101	95	101	88	27,730 mg
PENNSYLVANIA					
Wallenpaupack (P)	90	85	91	80	6,875 mcf
Pymatuning (FMR)	102	98	111	97	8,191 mcf
MARYLAND					
Baltimore municipal system (M)	101	100	101	91	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	100	99	99	90	12,580 mcf
High Rock Lake (P)	96	89	100	76	10,230 mcf
Narrows (Badin Lake) (P)	99	96	106	98	5,616 mcf
SOUTH CAROLINA					
Lake Murray (P)	96	95	98	77	70,300 mcf
Lakes Marion and Moultrie (P)	86	92	90	72	81,100 mcf
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	86	77	81	72	75,360 mcf
GEORGIA					
Burton (PR)	102	100	99	90	104,000 ac-ft
Lake Sidney Lanier (FMPR)	70	66	65	62	1,686,000 ac-ft
Sinclair (MPR)	92	94	93	91	214,000 ac-ft
ALABAMA					
Lake Martin (P)	100	100	96	90	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	83	75	70	59	1,156,000 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	91	86	86	65	1,452,000 cfsd
Douglas Lake (FPR)	97	85	85	65	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	95	92	87	79	512,200 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	99	92	94	82	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	99	96	94	87	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	94	91	71	82	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	29	31	37	41	1,640,000 ac-ft

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of May 1973	End of June 1973	End of June 1972	Average for end of June	Normal maximum
	Percent of normal maximum				
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	91	98	99	.....	22,640,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	92	92	90	79	1,948,000 ac-ft
OKLAHOMA					
Keystone (FPR)	113	92	80	103	661,000 ac-ft
Lake O' The Cherokees (FPR)	104	99	96	94	1,492,000 ac-ft
Tenkiller Ferry (FPR)	117	107	91	98	628,200 ac-ft
Lake Altus (FIMR)	68	75	24	65	134,500 ac-ft
Eufaula (FPR)	104	107	78	87	2,378,000 ac-ft
OKLAHOMA--TEXAS					
Lake Texoma (FMPRW)	105	105	86	100	2,722,000 ac-ft
TEXAS					
Possum Kingdom (IMPRW)	91	92	96	84	724,500 ac-ft
Buchanan (IMPW)	76	75	92	83	955,200 ac-ft
Bridgeport (IMW)	60	62	78	70	270,900 ac-ft
Eagle Mountain (IMW)	100	99	92	92	182,700 ac-ft
Medina Lake (I)	98	100	100	50	254,000 ac-ft
Lake Travis (FIMPRW)	99	97	94	78	1,144,000 ac-ft
Lake Kemp (IMW)	53	50	43	57	461,800 ac-ft
THE WEST					
ALBERTA					
Spray (P)	32	57	86	57	210,000 ac-ft
Lake Minnewanka (P)	65	91	93	60	199,700 ac-ft
St. Mary (I)	84	96	81	92	320,800 ac-ft
WASHINGTON					
Franklin D. Roosevelt Lake (IP)	33	58	93	98	5,232,000 ac-ft
Lake Chelan (PR)	62	93	91	97	676,100 ac-ft
IDAHO--WYOMING					
Upper Snake River (7 reservoirs) (IMP)	83	81	97	90	4,282,000 ac-ft
WYOMING					
Pathfinder, Seminoe, Alcova, Kortes, and Glendo Reservoirs (I)	97	94	82	50	3,016,000 ac-ft
Buffalo Bill (IP)	57	82	96	104	421,300 ac-ft
Boysen (FIP)	85	94	101	89	802,000 ac-ft
Keyhole (F)	87	86	91	41	199,900 ac-ft
COLORADO					
John Martin (FIR)	12	0	0	22	364,400 ac-ft
Colorado–Big Thompson project (I)	83	98	95	74	722,600 ac-ft
Taylor Park (IR)	55	89	102	97	106,000 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Navajo, and Blue Mesa Reservoirs (IFPR)	61	70	61	.....	31,276,500 ac-ft
UTAH--IDAHO					
Bear Lake (IPR)	87	88	98	68	1,421,000 ac-ft
CALIFORNIA					
Hetch Hetchy (MP)	76	100	90	81	360,400 ac-ft
Lake Almanor (P)	88	92	84	61	1,036,000 ac-ft
Shasta Lake (FIPR)	100	96	90	89	4,377,000 ac-ft
Millerton Lake (FI)	88	100	59	82	503,200 ac-ft
Pine Flat (FI)	79	94	48	67	1,014,000 ac-ft
Isabella (FIR)	50	72	21	42	551,800 ac-ft
Folsom (FIP)	98	94	95	93	1,000,000 ac-ft
Lake Berryessa (FIMW)	98	95	80	85	1,600,000 ac-ft
Clair Engle Lake (Lewiston) (P)	98	97	98	93	2,438,000 ac-ft
CALIFORNIA--NEVADA					
Lake Tahoe (IPR)	89	92	89	74	744,600 ac-ft
NEVADA					
Rye Patch (I)	105	106	98	.....	157,200 ac-ft
ARIZONA--NEVADA					
Lake Mead and Lake Mohave (FIMP)	81	81	67	71	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	77	74	5	14	1,093,000 ac-ft
Salt and Verde River system (IMPR)	99	96	38	42	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	89	87	32	78	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	26	31	7	29	2,539,000 ac-ft

[a] Thousands of kilowatt-hours.

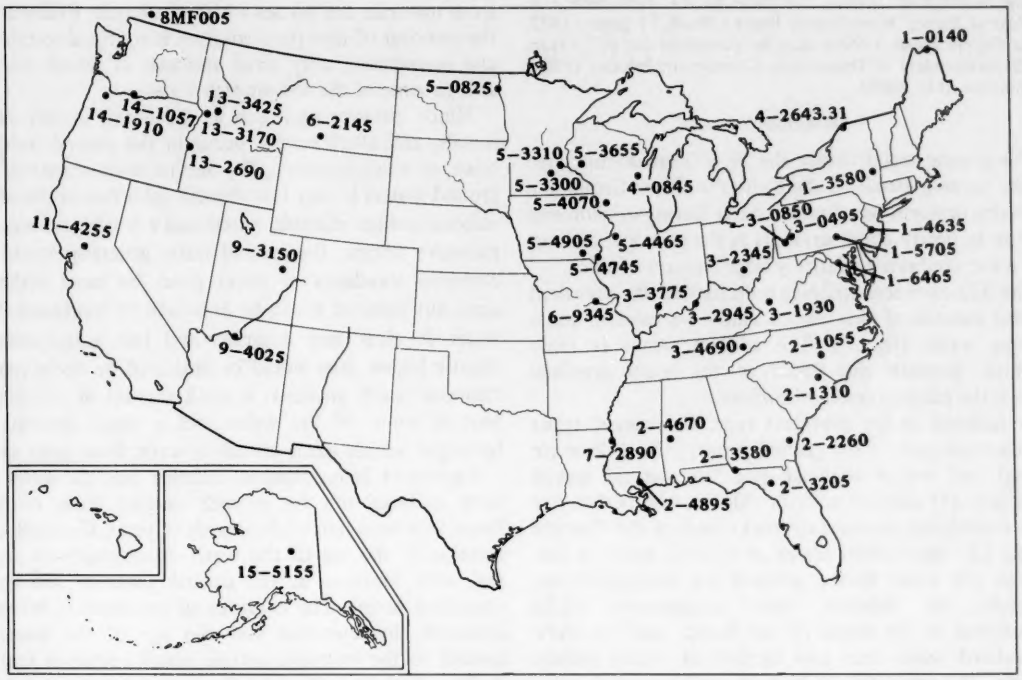
Provisional data; subject to revision

FLOW OF LARGE RIVERS DURING JUNE 1973

Station number	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1970 (cfs)	June 1973					
				Monthly discharge (cfs)	Percent of median monthly, discharge[1]	Change in discharge from previous month (percent)	Discharge near end of month		
							(cfs)	(mgd)	Date
1–0140	St. John River below Fish River at Fort Kent, Maine.	5,690	9,397	11,710	125	-72	4,500	2,900	30
1–3580	Hudson River at Green Island, N.Y.	8,090	12,520	11,661	141	-58	.....	.....	.....
1–4635	Delaware River at Trenton, N.J	6,780	11,360	13,233	189	-45	9,270	6,000	26
1–5705	Susquehanna River at Harrisburg, Pa.	24,100	33,670	32,210	140	-40	23,800	15,400	30
1–6465	Potomac River near Washington, D.C.	11,560	[2]10,640	12,900	174	-34	7,070	4,600	30
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	4,847	7,250	373	+59	15,300	9,900	30
2–1310	Pee Dee River at Peedee, S.C	8,830	9,098	14,300	242	+23	19,200	12,400	28
2–2260	Altamaha River at Doctortown, Ga.	13,600	13,380	22,920	267	+16	25,200	16,300	24
2–3205	Suwannee River at Branford, Fla	7,740	6,775	19,200	387	-20	13,400	8,700	23
2–3580	Apalachicola River at Chattahoochee, Fla.	17,200	21,690	37,100	226	+4	32,000	20,700	28
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	21,700	27,150	424	-26	30,300	19,600	24
2–4895	Pearl River near Bogalusa, La	6,630	8,533	6,688	187	-73	5,310	3,400	26
3–0495	Allegheny River at Natrona, Pa	11,410	[2]18,700	15,710	138	-45	9,100	5,900	27
3–0850	Monongahela River at Braddock, Pa.	7,337	[2]11,950	7,630	121	-60	3,400	2,200	27
3–1930	Kanawha River at Kanawha Falls, W.Va.	8,367	12,370	14,130	210	-32	8,080	5,200	26
3–2345	Scioto River at Higby, Ohio	5,131	4,337	9,580	470	+70	.....	.....	.....
3–2945	Ohio River at Louisville, Ky[3]	91,170	110,600	134,900	220	-37	86,400	55,800	27
3–3775	Wabash River at Mount Carmel, Ill.	28,600	26,310	42,750	201	+8	41,000	26,500	30
3–4690	French Broad River below Douglas Dam, Tenn.	4,543	[2]6,528	8,534	182	-39	.....	.....	.....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[3]	6,150	4,142	9,200	243	-41	.....	.....	.....
4–2643.31	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y.[4]	299,000	239,100	349,800	134	+4	350,000	226,000	30
5–0825	Red River of the North at Grand Forks N. Dak.	30,100	2,439	1,040	23	-24	840	500	30
5–3300	Minnesota River near Jordan, Minn ..	16,200	3,306	6,042	110	-36	3,400	2,200	28
5–3310	Mississippi River at St. Paul, Minn ...	36,800	[2]10,230	15,600	88	-28	8,710	5,600	28
5–3655	Chippewa River at Chippewa Falls, Wis.	5,600	5,062	7,052	126	-60	.....	.....	.....
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,457	16,351	167	-41	.....	.....	.....
5–4465	Rock River near Joslin, Ill	9,520	5,288	16,230	296	-38	12,000	7,800	28
5–4745	Mississippi River at Keokuk, Iowa ...	119,000	61,210	148,000	171	-35	92,000	59,500	29
5–4905	Des Moines River at Keosauqua, Iowa.	14,038	5,220	20,300	164	-30	18,500	12,000	29
6–2145	Yellowstone River at Billings, Mont.	11,795	6,754	20,660	78	+57	.....	.....	.....
6–9345	Missouri River at Hermann, Mo	528,200	78,480	112,700	103	-38	49,100	31,700	25
7–2890	Mississippi River near Vicksburg, Miss.[5]	1,144,500	552,700	1,245,000	210	-32	950,000	614,000	30
9–3150	Green River at Green River, Utah ...	40,600	6,369	18,721	96	-17	.....	.....	.....
9–4025	Colorado River near Grand Canyon, Ariz.	137,800	.....	12,440	.....	-7	.....	.....	.....
11–4255	Sacramento River at Verona, Calif ...	21,257	18,370	11,880	112	-15	11,200	7,200	25
13–2690	Snake River at Weiser, Idaho	69,200	17,670	11,110	45	-22	9,260	6,000	27
13–3170	Salmon River at White Bird, Idaho ..	13,550	11,060	18,620	48	-12	13,100	8,500	27
13–3425	Clearwater River at Spalding, Idaho ..	9,570	15,320	15,210	41	-14	13,300	8,600	27
14–1057	Columbia River at The Dalles, Oreg.[6]	237,000	194,000	143,300	32	-3	.....	.....	.....
14–1910	Willamette River at Salem, Oreg	7,280	23,370	6,206	46	-12	6,126	4,000	.....
15–5155	Tanana River at Nenana, Alaska	27,500	24,040	48,340	94	+60	68,700	44,400	23
8MF005	Fraser River at Hope, British Columbia.	78,300	95,300	222,000	90	+28	282,000	182,000	28

[1] Reference period 1931–60 or 1941–70.
[2] Adjusted.
[3] Record furnished by Corps of Engineers.
[4] Record furnished by Buffalo district, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.
[5] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[6] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

SELECTED STREAM-GAGING STATIONS ON LARGE RIVERS



Location of stream-gaging stations on large rivers listed in table on page 8.

WATER RESOURCES REVIEW — JUNE 1973

Cover map shows generalized pattern of streamflow for June based on 22 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for June 1973 is compared with flow for June in the 30-year reference period 1931–60 or 1941–70. Streamflow is considered to be *below normal* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for June is considered to be *above normal* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being within the *normal range.* In the Water Resources Review *normal flow* is defined as the median of the 30 flows of June during the reference period. The normal (median) has been obtained by ranking those 30 flows in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the normal (median).

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the June flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of June. Water level in each key observation well is compared with average level for the end of June determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels,* unless described otherwise, are from the end of May to the end of June.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. In the United States, issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Washington, D.C. 20244.

This issue was prepared by J.C. Kammerer, H.D. Brice, E.W. Coffay, I.G. Grossman, and L.C. Fleshmon from reports of the field offices, July 10, 1973.

QUALITY OF THE GROUND WATER IN BASALT OF THE COLUMBIA RIVER GROUP, WASHINGTON, OREGON, AND IDAHO

The accompanying abstract and graph are from the report, *Quality of the ground water in basalt of the Columbia River Group, Washington, Oregon, and Idaho,* by R.C. Newcomb: U.S. Geological Survey Water-Supply Paper 1999-N, 71 pages, 1972. Water-Supply Paper 1999-N may be purchased for $0.75 from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

ABSTRACT

The ground water within the 50,000-square-mile area of the layered basalt of the Columbia River Group is a generally uniform bicarbonate water having calcium and sodium in nearly equal amounts as the principal cations. The water contains a relatively large amount of silica.

The 525 chemical analyses indicate that the prevalent ground water is of two related kinds—a calcium and a sodium water (fig. 1). The sodium water is more common beneath the floors of the main synclinal valleys; the calcium water, elsewhere.

In addition to the prevalent type, five special types form a small part of the ground water; four of these are natural and one is artificial. The four natural special types are: (1) calcium sodium chloride waters that rise from underlying sedimentary rocks west of the Cascade Range, (2) mineralized water at or near warm or hot springs, (3) water having unusual ion concentrations, especially of chloride, near sedimentary rocks intercalated at the edges of the basalt, and (4) more mineralized water near one locality of excess carbon dioxide. The one artificial kind of special ground water has resulted from unintentional artificial recharge incidental to irrigation in parts of central Washington.

The solids dissolved in the ground water have been picked up on the surface, within the overburden, and from minerals and glasses within the basalt. Evidence for the removal of ions from solution is confined to calcium and magnesium, only small amounts of which are present in some of the sodium-rich water.

Minor constituents, such as the heavy metals, alkali metals, and alkali earths, occur in the ground water in trace, or small, amounts. The natural radioactivity of the ground waters is very low. Except for a few of the saline calcium sodium chloride waters and a few occurrences of excessive nitrate, the ground water generally meets the common standards of water good for most ordinary uses, but some of it can be improved by treatment. The water is clear and colorless and has a temperature slightly higher than would be indicated by the accepted "normal" earth gradient. A small amount of iron is present in some of the water and a slight amount of hydrogen sulfide gas is present in water from most wells.

Carbon-14 determinations indicate that the water has been underground for periods ranging from modern times to several tens of thousands of years. Generally, an increase in the age of the water corresponds to depth and with location in the central parts of the main structural basins. The evidence of correlations between chemical characteristics and the age of the water is limited to the excessive nitrate which occurs in young, shallow ground water and the apparent base-exchange removal of calcium and mangesium that has occurred where the ground water is old.

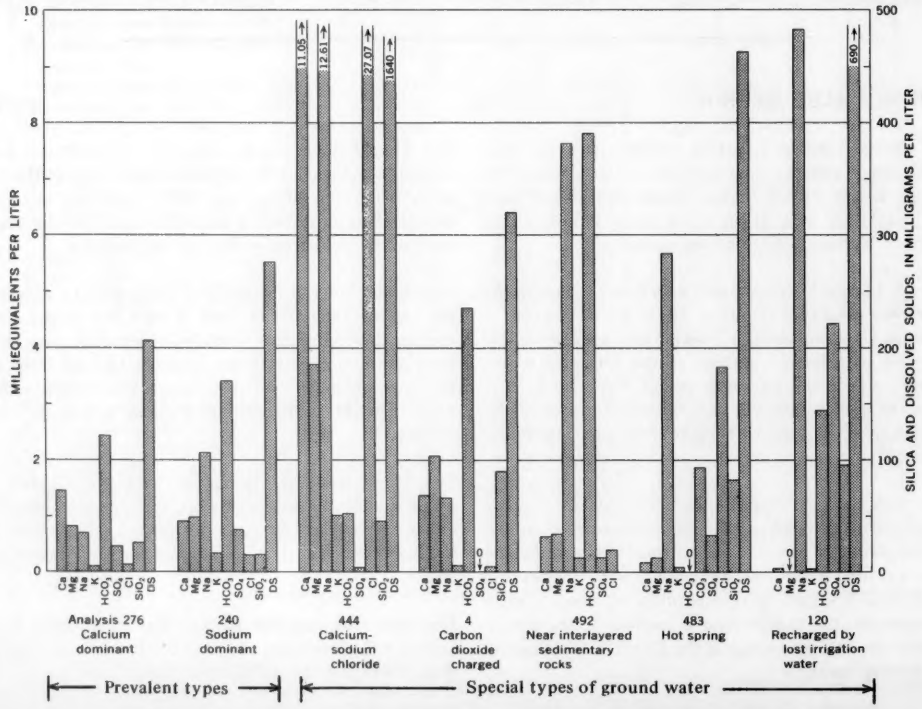


Figure 1.—Selected analyses of the prevalent and special types of ground water.

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